State Energy Efficiency Resource Standards: Design, Status, and Impacts

D. Steinberg and O. Zinaman

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Abstract

An energy efficiency resource standard (EERS) is a policy that requires utilities or other entities to achieve a specified amount of energy savings through energy efficiency programs within a specified timeframe. These standards can require electricity savings, natural gas savings, or both. This paper reviews the key design features of EERSs for electricity, explores state-level design variations in EERSs, and provides an estimate of the savings required by currently specified EERSs in each state. As of January 2014, 23 states had active and binding EERSs for electricity. Assuming each state that has adopted an EERS achieves full compliance with their targets, we estimate that state EERSs will reduce electricity consumption by approximately 5% below the projected level of consumption by 2015 and 8%–10% by 2020. This corresponds to a reduction in national electricity consumption of approximately 3% in 2015 and 4%–6% in 2020. The level of savings required by the policies varies significantly across states—from as low as 1% (in Texas) to as high as 15% (in New York) in 2015. In addition to the variation in savings required by the standards, variation in key design elements of EERSs across states leads to important differences in the suite of incentives created by the standards, the compliance flexibility associated with the standards, the balance of benefits and costs of the standards between utilities and consumers, and the certainty with which the standards will drive long-term savings.

1 Introduction

State and utility efforts to increase energy efficiency were first initiated following the energy crisis of the mid-1970s in order to reduce the impact of soaring energy prices on consumers (Nowak et al. 2011; Gillingham et al. 2006). Since then, states have implemented a diverse mix of programs and policies to promote investment in and overcome barriers to energy efficiency, including the development of building energy codes, minimum efficiency standards for appliances, rebates and tax credits, information programs, and consumer behavioral programs.[1] In earlier years, these policies and programs were justified largely as a means of reducing costs to end-use customers, but over time this justification has evolved to include the contribution that efficiency policies make toward environmental, health, and economic development goals, such as reducing emissions of greenhouse gases (GHGs) and criteria pollutants.[2]

Beginning with Texas in 1999, and increasingly in the past 5–10 years, many states have chosen to adopt a policy or standard that requires utilities or other entities to achieve a minimum amount of energy savings over a specified time period through energy efficiency programs. These policies are typically referred to as energy efficiency resource standards (EERSs) or energy efficiency portfolio standards (EEPSs).[3] EERSs are distinct from other types of efficiency policies in that they do not mandate a specific efficiency measure or set of measures but rather require a minimum amount of savings and allow utilities and other obligated entities to choose how to best achieve those savings.

Beyond offering flexibility, EERSs have a number of other potential benefits. First, they provide defined targets that utilities can incorporate into their strategic planning and that regulators can use to evaluate performance. Second, EERSs encourage utilities (and other obligated entities) to minimize the cost per unit of energy saved. In the past, some states had implemented minimum spending mandates for efficiency programs, which guaranteed investment in efficiency but provided no incentive to maximize cost-effectiveness. Lastly, because EERSs set a minimum level of required savings, they ensure that states make progress toward achieving overall efficiency goals, as well as associated environmental, health, and economic development goals.

In addition to the potential benefits of an EERS, there are also a range of potential challenges and costs associated with the implementation and operation of an EERS. Administration of an EERS involves organization and communication between a broad group of entities, including the public utilities commission (PUC), load-serving entities (LSEs) or other obligated entities, efficiency program administrators, and program evaluators. Measurement and verification of energy savings resulting from energy efficiency programs can be a particular challenge, not only because of the multiple entities involved, but also due to the complexity of estimation methods. However, almost every state has experience administering some form of an efficiency program,

[1] See Gillingham et al. (2006) for a retrospective review of efficiency policy in the United States.
[2] For example, see the New York Department of Public Service's 2008 order establishing the Energy Efficiency Portfolio Standard (Case 07-M-0548, http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId=%7BD9F7E0DF-A518-4199-84CC-C2E03950A28D%7D) and California's Assembly Bill 2021 (http://www.energy.ca.gov/sb1/meetings/ab_2021_bill_20060929_chaptered.pdf).
[3] In this paper we will use the term EERS throughout.

and with the wide variety of programs in operation nationally, there is a wealth of knowledge and capability to leverage.

Currently, 23 states have EERS programs. EERSs can require savings in electricity and/or natural gas consumption;[4] however, this paper focuses solely on electricity EERSs. There is a large amount of variation across states in how EERSs are structured and administered, the level of stringency and timing of targets, the entities that are required to comply with the targets, the eligible savings measures that can contribute to compliance, how the programs are funded, how they are enforced, and how savings are measured. In this paper, we review the key design features of EERSs and the challenges and benefits of variations in those design features; to inform this design discussion, we also evaluate the relative stringency of existing EERSs by developing an estimate of the savings required under each state's standard.

Moreover, forthcoming regulation from the U.S. Environmental Protection Agency (EPA) limiting GHG emissions from existing power plants has renewed interest in energy efficiency policy design and the extent to which energy efficiency can contribute to state GHG emissions reduction goals. Specifically, on June 25, 2013, President Obama issued a memorandum directing EPA to issue standards and guidelines for existing fossil-fuel-fired power plants.[5] As part of this process, EPA is expected to release draft guidelines to states for reducing GHG emissions from existing power plants by June 2014, and final guidelines to states by June 2015. States must then submit implementation plans to EPA for review and approval by June 2016. Many states and stakeholders have called for inclusion of GHG reductions from state efficiency programs and policies, including EERSs, adding a new level of interest in the design of state EERSs, and approaches for allowing savings resulting from EERSs to contribute toward compliance with forthcoming regulations.[6,7]

[4] Twenty-three states have an EERS for electricity, and 15 of those states also have an EERS for natural gas.

[5] Presidential Memorandum, Power Sector Carbon Pollution Standards, June, 25, 2013, http://www.whitehouse.gov/the-press-office/2013/06/25/presidential-memorandum-power-sector-carbon-pollution-standards.

[6] Open letter to EPA Administrator, Gina McCarthy, from 15 state environment and energy leaders. Accessed January 15, 2014: http://www.georgetownclimate.org/sites/default/files/EPA_Submission_from_States-FinalCompl.pdf.

[7] Report on Emission Reduction Efforts of the States Participating in the Regional Greenhouse Gas Initiative and Recommendations for Guidelines under Section 111(d) of the Clean Air Act. Regional Greenhouse Gas Initiative. Accessed January 15, 2014: http://www.rggi.org/docs/RGGI_States_111d_Letter_Comments.pdf.

2 Status of State EERSs

We define an EERS as any quantitative and legally binding obligation to achieve a specified amount of energy savings within a specified time frame. Again, this paper only considers EERSs for electricity. Currently, 23 states have active EERSs, 4 states have voluntary, uncertain, or underfunded EERSs,[8] and 2 additional states allow energy efficiency savings to contribute toward their renewable portfolio standard (RPS).[9]

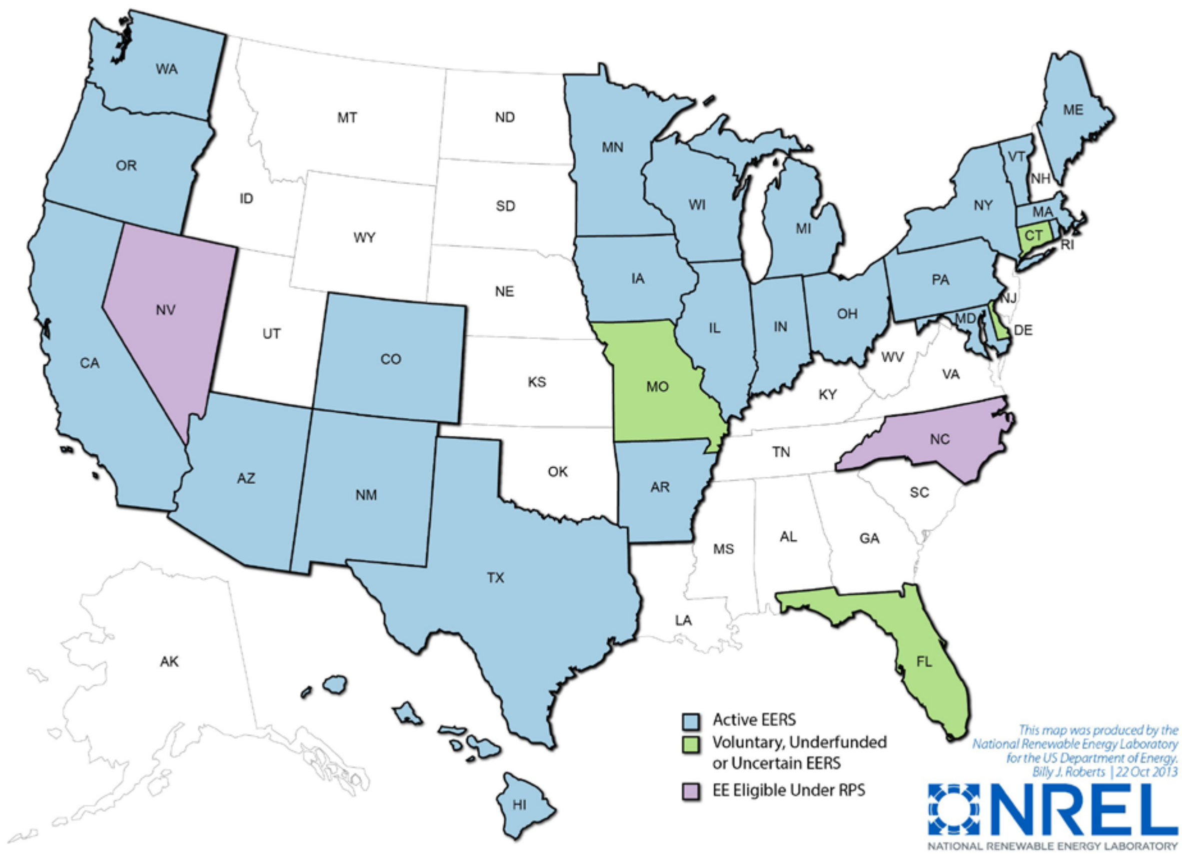

Figure 1. Status of state EERSs, as of January 2014

According to utility and state reporting, states have generally achieved full or near full compliance with EERS targets in recent years (Sciortino et al. 2011; Nadel and Shenot 2011).[10] In addition, among those states with EERSs, the large majority have maintained or increased the

[8] In states where the EERS is voluntary there is no legally binding requirement to achieve a specified amount of electricity savings. In states where the EERS is underfunded, although a requirement was put in place to achieve a specified amount of savings, the regulatory commission has not approved the use of sufficient funds to achieve the savings targets, and therefore it is unlikely that compliance will be achieved.

[9] In total, eight states allow energy efficiency to contribute towards RPS compliance. However, six of those states also have standalone EERSs.

[10] In addition to Sciortino et al., some state PUCs publish periodic reports on EERS compliance. For example, see the California PUC's 2010–2011 Energy Efficiency Annual Progress Evaluation Report, http://www.cpuc.ca.gov/NR/rdonlyres/89718A1B-C3D5-4E30-9A82-74ED155D0485/0/EnergyEfficiencyEvaluationReport.pdf.

stringency of their EERS targets, with the exception of New Mexico and Illinois. New Mexico recently lowered its statutory EERS targets,[11] and in Illinois, while the statutory targets remain the same, the PUC lowered the utility specific requirements in order to bring EERS compliance costs below a statutory cost cap.[12]

[11] See New Mexico House Bill 267, http://www.nmlegis.gov/Sessions/13%20Regular/bills/house/HB0267.pdf.
[12] See Illinois Final Order Docket No. 10-0568, 12/21/2010, and subsequent Plan submitted by Ameren Illinois Company, 01/20/2011.

3 EERS Structure and Design

At the most basic level an EERS requires three key features:

1. Quantitative targets specifying a required amount of energy savings over a specified period
2. An entity or group of entities required to meet the targets and demonstrate compliance
3. A set of energy savings activities that can be used to meet the targets

How these three features are designed, as well as whether other provisions are included—for instance, incentives and penalties for compliance and non-compliance—determines the flexibility and coverage of the policy; the incentives created by the policy; the balance of customer and utility benefits, costs, and risks; and the overall stringency and impacts of the policy. In this section we review the key design features of an EERS, discuss the potential impacts of alternative design choices on policy outcomes, and report on the variation in design across states. Specifically, we examine:

- Authorities for creation and implementation
- Target type
- Target stringency
- Responsible entities and covered load
- Eligible savings measures
- Cost recovery
- Cost containment
- Incentives, penalties, and decoupling
- Evaluation, measurement, and verification of savings

3.1 Authorities

EERSs are enacted either through state legislation, or, alternatively, by order from the state PUC. In the latter case, the PUC can create the EERS under specific instruction from the state legislature or can establish the standard under its own authority—for example, as a means of minimizing costs to customers. Regardless of whether the EERS is enacted through legislation or by order from the PUC, the PUC always plays a central role in the design and implementation of the standard. In 16 of the 23 states with active EERSs, the policy was initiated through state legislation.[13]

3.2 Target Type

Savings targets can be defined in a variety of ways, and indeed states vary significantly in their approaches to target specification. First, targets can be specified in either "incremental" or "annual" terms. These terms are not used consistently across states, which can complicate the

[13] EERSs were initiated through legislation in the following states: CO, HI, IA, IL, MA, MD, ME, MI, MN, NM, OH, PA, RI, TX, VT, and WI.

interpretation of the nominal[14] targets. In this paper, our definitions for incremental and annual savings are consistent with those proposed in the State and Local Energy Efficiency Action Network's *Energy Efficiency Program Impact Evaluation Guide* (Schiller 2012).

Incremental savings refers to the reduction in electricity use in a given year resulting from energy efficiency measures installed in that year. *Annual savings*[15] refers to the reduction in electricity use in a given year resulting from energy efficiency measures installed in that year and measures installed in prior years that continue to provide savings.[16] Table 1 provides an example of the different types of saving metrics defined above for a hypothetical EERS starting in 2014. We define the *reference consumption* as the amount of electricity that would have been consumed in the absence of the EERS.

Table 1. Example Showing Differences in Savings Metrics[a]

	2014	2015	2016
Reference Case Electricity Consumption (GWh)	1000	1100	1200
Adjusted Electricity Consumption under an EERS (GWh)	950	980	1020
Annual Savings (GWh)	50	120	180
Incremental Savings (GWh)	50	70	60

[a] It is assumed that savings measures installed prior to 2014 do not contribute toward the annual savings.

Second, in addition to variation in the type of target (incremental or annual), EERSs can also differ in the units in which targets are specified: They can either be defined in absolute terms (e.g., X GWh/yr) or in relative terms (e.g., savings equivalent to Y% of 20ZZ electricity consumption). Targets that are specified in absolute terms are straightforward to interpret, as the amount of savings required is explicitly stated. For targets specified in relative terms, one needs to define the quantity from which the relative (percentage) reduction is calculated. Following Palmer et al. (2013), we refer to this quantity as the *basis*. For example, New Mexico's EERS requires annual savings equivalent to 8% of 2005 electricity consumption by 2020. In this example, the basis would be the level of electricity consumption in 2005.

There are two types of bases: fixed and rolling. A relative target with a fixed basis (fixed-relative) uses electricity consumption in a fixed period to calculate the required level of savings. For example, Arkansas's targets are specified relative to electricity consumption in 2010. The EERS requires that incremental savings in 2014 and 2015 are equivalent to 0.75% and 0.9% of electricity consumption in 2010, respectively. Because the basis does not change with the compliance year, it is a fixed basis. A relative target with a rolling basis (rolling-relative) uses electricity consumption in a moving period that changes with the compliance year. Rolling bases can be electricity consumption in the year prior to the compliance year, projected electricity

[14] *Nominal* targets refer to the targets as stated in the specification of the EERS.
[15] State statutes and PUC orders under which EERSs are implemented sometimes use the term "cumulative" savings to refer to what we define as "annual" savings.
[16] Policies that use annual savings can define a base year that specifies the earliest year in which savings measures are eligible to contribute toward compliance. For example, see Arizona Corporation Commission Docket No. RE-00000C-09-0427,
http://www.swenergy.org/news/news/documents/file/Arizona%20EE%20Ruling%20Approved%2012-16-09.pdf.

consumption in the current year,[17] or an average of electricity consumption over multiple previous years. For example, Iowa's targets are specified relative to average electricity consumption in the three years prior to the compliance year. Because the basis changes as the compliance year changes, it is a rolling basis. Table 2 shows how targets are specified in each state, including the target type, units that the targets are specified in, the basis (for relative targets), and the nominal target in the final year of the policy.

Table 2. State EERS Target Type, Units, Basis Type, Basis, and Nominal Targets in the Final Year of the Policy.

	Target Type	Unit	Basis Type	Basis	Nominal Target as Specified in Final Year of Policy[§]
AR	Incremental Savings	%	Fixed	2010 Consumpt.	0.75% (2014)
AZ	Annual Savings	%	Rolling	Previous Yr's Consumpt.	22.0% (2020)
CA	Incremental Savings	GWh	N/A	-	1,968 GWh (2014)
CO	Incremental Savings	GWh	N/A	-	549 GWh (2020)
HI	Annual Savings	GWh	N/A	-	4,300 GWh (2030)
IA	Incremental Savings	%	Rolling	Avg. of Previous 3 Yrs' Consumpt.	1.3% (2013)
IL	Incremental Savings	%	Rolling	Previous Yr's Consumpt.	2.0% (2015 -)‡
IN	Incremental Savings	%	Rolling	Avg. of Previous 3 Yrs' Weather-Norm. Consumpt.	2.0% (2019)
MA	Incremental Savings	GWh	N/A	-	1,275 GWh (2015)
MD	Annual Savings	%*	Fixed	2007 Per Capita Electricity Consumpt.	15% (2015)
ME	Incremental Savings	GWh	N/A	-	139 GWh (2016)
MI	Incremental Savings	%	Rolling	Previous Yr's Consumpt.	1.0% (2012 -)‡
MN	Incremental Savings	%	Rolling	Avg. of Previous 3 Yrs' Weather-Norm. Consumpt.	1.5% (2010 -)‡
NM	Annual Savings	%	Fixed	2005 Electricity Consumpt.	8.0% (2020)
NY	Annual Savings	%	Fixed	2015 Electricity Consumpt. (forecasted)	15.0% (2015)
OH	Annual Savings	%	Rolling	Avg. of Previous 3 Yrs' Consumpt.	22.0% (2025)
OR	Incremental Savings	GWh	N/A	-	491 GWh (2014)
PA	Annual Savings	%	Fixed	June 2009 - May 2010 Consumpt.	5.3% (2016)
RI	Incremental Savings	GWh	N/A	-	189 GWh (2014)
TX	Incremental Savings	%†	Rolling	Avg. of Previous 5 Yr's Load Growth	30% (2013 -)‡
VT	Annual Savings	GWh	N/A	-	320 GWh (2014)
WA	Annual Savings	GWh	N/A	-	8,745 GWh (2021)
WI	Annual Savings	GWh	N/A	-	1,816 GWh (2014)

* Maryland targets are specified as a percent of per capita electricity consumption.
† Texas targets are specified as a percent of electricity demand growth.
‡ In these states, targets apply to the specified year and all years following.
§ Given that the nominal specifications of the EERS targets are listed and the final year of the policy varies, these targets cannot be directly compared across states.

Equivalent savings targets can be achieved using any of the above approaches for target specification. However, there are trade-offs associated with the different approaches. First, using incremental targets reduces the complexity of assessing compliance relative to using annual savings targets. Compliance with incremental targets solely requires accounting for (or

[17] In cases where the rolling basis is electricity consumption in the current year, the electricity consumption referenced is the amount of electricity that would have been consumed in the absence of the EERS, or the *reference consumption*, as defined above.

estimation of) savings from measures installed in the compliance year, whereas assessing compliance with annual savings targets requires accounting for savings from measures installed both in the compliance year and previous years (as specified by the policy), as well as any degradation or erosion of savings from measures installed in previous years.

Second, although assessing compliance with annual savings targets is more complex than with incremental savings targets, the fact that compliance is dependent not only on the savings measures installed in the compliance year, but also in previous years, can enhance the certainty with which long-term energy savings goals are achieved. Under an EERS that uses annual savings targets, if savings are below the target in the year prior to a compliance year, it is necessary to achieve an increased level of savings in the compliance year. Alternatively, with incremental targets, compliance is only dependent on savings in the compliance year and, therefore, under-compliance in prior years does not require increased savings in the compliance year, potentially lowering savings relative to goals over the long term. Of course, a policy using incremental targets could be designed such that if targets are not met consistently, they are adjusted upwards in future years to keep a state on track toward meeting its longer-term efficiency goals, but this requires intervention rather than being automatic.

Third, incremental and annual targets generate different incentives for utilities or obligated entities with regard to the persistence or lifetime of efficiency measures they install. Under both target types, obligated entities are incentivized to identify and pursue the most cost-effective efficiency measures. However, under incremental targets, obligated entities may choose to pursue low-cost, short-lifetime measures over more costly measures that save more energy and may be more cost-effective over the long term, as compliance is only dependent on the incremental savings in a given compliance year. Under annual targets, obligated entities are incentivized to identify low-cost measures that achieve both near- and long-term savings, as compliance in a given year is not only dependent on measures installed in that year, but also on measures installed in previous years that continue to provide savings. Furthermore, the importance of long-term savings under annual targets may induce more rigorous efforts by obligated entities to evaluate the long-term impacts of individual efficiency measures, in order to ensure that they are pursuing the most cost-effective options.

Lastly, absolute targets and fixed-relative targets are easier to assess than rolling-relative targets. Absolute targets and fixed-relative targets require no calculations or limited calculations, respectively, while rolling-relative targets require new calculations each year. In addition, absolute and fixed-relative targets provide certainty to the policy administrator and to the obligated entities on the level of savings required. However, absolute and fixed-relative targets are not responsive to changes in system conditions, such as changes in electricity consumption due to population changes or market events. For instance, if there is unexpected growth in electricity consumption in future years, one might assume that a greater level of savings is justified. Unless absolute (or fixed-relative) targets are reassessed and adjusted, the change in consumption will have no impact on the required savings. Rolling-relative targets, on the other hand, scale relative to consumption in the basis year (or years), depending on the policy, resulting in a savings requirement that increases or decreases depending on trends in overall electricity consumption. Again, if targets are periodically reviewed, absolute or fixed-relative targets could be adjusted to account for changes in consumption or other conditions, but this is not automatic.

In sum, incremental targets offer simplicity, whereas annual targets enhance the certainty with which longer-term savings goals can be achieved and incentivize investment in efficiency measures that provide the lowest cost savings over the long term. Absolute and fixed-relative targets provide greater simplicity and certainty than rolling-relative targets, but rolling-relative targets are more responsive to changing market conditions. These tradeoffs are important to consider when designing or revising EERSs.

3.3 Target Stringency

The levels of the targets chosen by a state, the coverage of the policy, and how the targets are specified ultimately determine the amount of savings required by the policy. Additional provisions, such as cost caps or alternative compliance payments, have the potential to reduce the level of required savings, but the target levels and specification[18] are ultimately what determine the amount of savings that the policy is intended to achieve. As a result, setting the target levels is one of the most important design elements of an EERS.

The appropriate level at which to set targets depends on policy objectives, the potential for efficiency improvements, and the cost-effectiveness of available efficiency measures, all of which vary by state. In theory, if the objective of the policy is to achieve all cost-effective efficiency potential, targets should be set at a level such that the marginal cost of a savings measure is equal to its marginal benefit.[19] This requires an estimate of the level of savings at which this condition is met, which may be approximated through an efficiency potential study (including a cost-effectiveness analysis).[20]

In practice, many states carry out analyses in order to estimate the amount of cost-effective efficiency potential available within their state and use that as a basis from which to set targets.[21] Alternatively, some states can set targets simply based on existing knowledge of the level of achievable efficiency potential, relying on previously published studies, experience with existing efficiency programs within the state, results or experiences from similar states, and/or expert opinion.[22]

3.3.1 Examining Existing Targets

Given the considerable variation in how EERS targets are specified (e.g., incremental vs. annual, absolute vs. relative, fixed vs. rolling), it is difficult to directly compare the stringency or savings required by EERS policies across states based on the nominal targets. In order to carry out these

[18] Given specific targets—for example, for years 2014 and 2015, savings must be equivalent to 2% and 3% of 2013 consumption—how those targets are specified greatly impacts the level of savings required. For instance, if these targets are specified as incremental, in 2015, the annual savings required would be 5% of 2013 consumption. Alternatively, if the targets are specified as annual targets, the annual savings required in 2015 would only be 3% of 2013 consumption. Thus, states must be careful to consider target specification in conjunction with target level.

[19] The marginal benefit of efficiency should theoretically include the full stream of benefits from efficiency (i.e., the full social benefit), including avoided energy expenditures, as well as the health and environmental benefits associated with emissions reductions.

[20] For additional discussion on target setting, see Kushler et al. (2006), Nadel and Shenot (2011), and Mosenthal and Loiter (2007).

[21] For example, see "Electric Energy Efficiency Potential for Vermont," 2011, prepared by GDS Associates and the Cadmus Group.

[22] For example, see S. Straton and D. York, "A Review and Analysis of Existing Studies of the Energy Efficiency Resource Potential in the Midwest," 2009.

comparisons, we converted all nominal targets into consistent units, taking into account target specification, future electricity demand, and the portion of demand that the policy covers (policy coverage is discussed in greater detail in Section 3.4). A summary of the results comparing the stringency of state EERS targets as a percent of total state load is provided in Table 3, and a detailed description of the methods and results can be found in the Appendix, along with a comparison to related studies.

Although we provide a detailed description of the results in the Appendix, it is important to highlight one key consideration about the estimates presented. A number of state EERSs have targets that terminate well before 2020. As a result, in order to estimate the required savings in years following the termination year, an assumption must be made about the future trajectory of these states' targets. Given the high degree of uncertainty about whether and how different states will extend their targets in future years, the analysis was completed using two different approaches to extending targets. Under the first approach (Method 1), it is assumed that the annual savings required in the years without specified targets is equal to the annual savings required in the final target year. Given that we also assume that the savings from measures installed during the analysis period persist through 2020 with no erosion of performance, this methodology effectively assumes that no additional incremental savings are required beyond what is currently required by policy in the final year. This approach will generally make states with only near-term targets appear less stringent than states with longer-term targets, as the method implicitly assumes that states with near-term targets do not implement any future EE measures after the final year of the policy. Under the second approach (Method 2), it is assumed that the incremental savings required in the years without specified targets is equal to the incremental savings required in the final target year. In contrast to the preceding approach, this method may exaggerate the level of savings required by 2020 in states with near-term targets if those states require a significant amount of incremental savings in the final target year of the policy. Given the uncertainty in the projected targets for states with targets that terminate prior to 2020, we stress the much greater degree of certainty in the 2015 results.

There is a considerable amount of variation in the level of savings required by state EERSs. Table 3 shows the estimates of the annual electricity savings required by 2015 and 2020 by state for all currently active EERSs. The values shown refer to the amount of annual savings required in the specified year as a percent of reference case consumption in that year.

Table 3. Estimates of the Required Savings in 2015 and 2020 as a Percent of Reference Case State Electricity Consumption.*

State	Final Year of Target	*Method 1 - Annual Savings Held Constant in Final Year of Target* Annual Savings Required in 2015 (% of State Load)	Annual Savings Required in 2020 (% of State Load)	*Method 2 - Incremental Savings Held Constant in Final Year of Target* Annual Savings Required in 2015 (% of State Load)	Annual Savings Required in 2020 (% of State Load)
AR	2014	2.7%	2.5%	2.7%	6.2%
AZ	2020	5.3%	11.4%	5.3%	11.4%
CA	2014	4.0%	3.8%	3.0%	6.5%
CO	2020	3.7%	7.7%	3.7%	7.7%
HI	2030	11.0%	19.0%	11.0%	19.0%
IA	2013	3.8%	3.8%	5.6%	10.0%
IL	2020	6.5%	14.4%	6.5%	14.4%
IN	2019	3.8%	9.2%	3.8%	10.7%
MA	2015	10.8%	10.6%	10.8%	21.1%
MD	2015	14.2%	14.7%	14.2%	27.2%
ME	2016	7.1%	8.2%	7.1%	12.9%
MI	2020	5.1%	9.7%	5.1%	9.7%
MN	2020	8.7%	15.3%	8.7%	15.3%
NM	2020	3.6%	5.2%	3.6%	5.2%
NY	2015	15.0%	15.0%	15.0%	27.5%
OH	2025	4.6%	10.3%	4.6%	10.3%
OR	2014	4.7%	4.5%	5.7%	10.5%
PA	2016	4.3%	5.0%	4.3%	7.8%
RI	2014	8.4%	8.3%	10.8%	22.7%
TX	2020	1.1%	2.6%	1.1%	2.6%
VT	2014	9.9%	9.8%	11.8%	21.0%
WA	2021	4.7%	8.1%	4.7%	8.1%
WI	2014	2.7%	2.6%	3.3%	6.6%

*The annual savings requirements are shown as a percentage of projected total state electricity consumption under the reference case—our estimate of the electricity that would have been consumed in the absence of the EERS. It is assumed that savings measures installed prior to 2010 do not contribute towards compliance.

Annual savings required by state EERSs range from approximately 1% to 15% of reference consumption in 2015, irrespective of the approach used to extend targets, and from 2% to 19% or 2% to 27% in 2020, depending on whether target extensions are based on annual or incremental savings.

The consumption weighted mean of the annual savings required as a percent of total reference load is approximately 5% in 2015. This suggests that in states with EERSs, if targets are fully met, on average, electricity consumption in 2015 will be 5% lower than it would have been in the absence of the policy. By 2020, we estimate that electricity consumption would be, on average, approximately 8%–10% below reference consumption in states with EERSs depending on how states extend their targets in future years. This is equivalent to achieving incremental savings of approximately 0.7%–1% per year.

Arizona, Hawaii, Illinois, Massachusetts, Maryland, Minnesota, New York, Ohio, and Vermont appear to require the largest amount of savings. These states all require annual savings of at least

5% by 2015 and savings of at least 10% by 2020.[23] This represents incremental savings of approximately 0.8% per year between 2010 and 2015, and 0.9% per year between 2010 and 2020.

3.4 Responsible Entities and Covered Load

The responsibility of compliance with an EERS can be placed on a state's LSEs (or some subset thereof), a third-party organization, a government body, or some combination of these options. The obligated entity (or entities) are then responsible for designing, implementing, and operating efficiency programs. In some cases, the obligated entity carries out this work directly, and in other cases, they may rely on a third-party to design, implement, and operate the programs.

There are various institutional, market, and political considerations that influence the selection of the obligated entity, and there are benefits and challenges to the different structures or approaches that states have taken.[24] Currently the most common approach is to assign responsibility of compliance to LSEs. Historically, administration and implementation of energy efficiency programs have been carried out by LSEs (as utility demand-side resource investments), and as a result, in many states, LSEs have developed valuable infrastructure, staff, and relationships with efficiency professionals. Placing the responsibility of compliance on LSEs, allows this infrastructure and these capabilities to be leveraged, whereas placing the requirement on a non-LSE entity risks losing this institutional knowledge and infrastructure.[25] In addition to the institutional knowledge and infrastructure held by many LSEs, there are two other benefits to placing the obligation on LSEs. First, many LSEs (either by choice or by requirement), include efficiency as a resource option within their integrated resource planning frameworks. Placing the obligation on LSEs, therefore, allows LSEs to include EERS considerations within their planning activities. Second, LSEs have direct relationships with customers and knowledge about their preferences and consumption patterns. This gives LSEs key insight into the probable success of different types of efficiency programs, as well as a direct line of communication through which to promote or advertise programs.

There are two significant challenges associated with placing the obligation on LSEs. First, the traditional business model of an LSE is in conflict with investment in energy efficiency. Specifically, in the absence of mitigating policies, LSEs have a disincentive to invest in efficiency, as successful efficiency programs result in lower energy sales and lower utility revenues. As a result, states that place the obligation on LSEs typically allow for revenue decoupling and offer monetary incentives for performance in order to both remove this disincentive in efficiency investment and to encourage compliance. Second, the jurisdiction of an LSE is limited to the customers and amount of load served within the LSE's service territory. Many states that place the obligation on LSEs choose to limit the obligation to LSEs that meet requirements with regard to ownership structure (e.g., all investor-owned utilities [IOUs]) and/or

[23] Depending on whether and how these states extend targets in future years, the EERSs could require savings ranging from 10% to 27% of reference consumption in 2020.
[24] For a complete discussion of selection of obligated entities, see "Who Should Deliver Ratepayer-Funded Energy Efficiency? A 2011 Update," Sedano, 2011.
[25] If a state does choose to place the requirement on a third-party or government entity, efforts can be made to retain essential staff, knowledge, and relationships from prior utility-run programs.

minimum thresholds for their annual revenues or the size of their customer base.[26] This typically serves to exempt smaller LSEs from compliance, including municipal and cooperative utilities, and reduce the portion of total state load covered by the policy. As a result of these exemptions, customers in these service areas may not have the opportunity to participate in energy efficiency programs, and the overall state savings requirements can be diminished relative to a standard that covers all load.

Placing the obligation on a third-party entity, either a non-governmental entity (as is the case in Indiana, Maine, Oregon, Vermont, and Wisconsin), or government body (as is the case in Illinois, Maryland, and New York), provides a mechanism to circumvent both of these challenges. Neither a non-governmental third-party entity nor a government body has any inherent disincentive to invest in energy efficiency, and neither have inherent jurisdictional boundaries that limit their ability to reach customers. In the case of a non-governmental entity, there is the additional benefit that the mission of the entity can be completely aligned with the policy objectives.

Although there are clear benefits to the third-party approach, there are also costs and challenges. There are significant start-up costs associated with the creation of a new entity (or adaptation of an existing entity) charged with achieving compliance. Furthermore, there may be constraints on the ability of a new or recently adapted entity to ramp up in size (to grow staff, establish relationships and infrastructure), limiting the potential amount of achievable savings in the early years of a policy.

Finally, placing the requirement on a government entity creates an additional set of risks. Changes in state politics or state policy goals have the potential to reduce focus on energy efficiency and erode funding for efficiency programs. Procurement restrictions on state government agencies may limit flexibility in contracting with efficiency program administrators, hiring restrictions could limit a state's ability to onboard the most qualified staff, and the state entity may be viewed as a competitor to privately owned efficiency companies.

As is evident, there are a broad range of considerations associated with the selection of the obligated entity, and as a result, we observe a broad range of approaches from states that have implemented EERSs. Furthermore, as states have gained experience with their programs, some have decided to transition from one type of structure to another, demonstrating that as conditions and markets change, the structure of obligation can change with it.

[26] Exemption of smaller LSEs from compliance is sometimes a direct result of the jurisdiction of the PUC, while in other cases, states may choose to exempt these entities from compliance as small LSEs may face a higher burden of compliance due to fewer customers over which to share administrative costs of EE.

Table 4. Responsible Entities and Covered Load

State	Responsible Entities*	Covered Load	Additional Notes
AR	IOUs, Co-ops	87%	
AZ	All LSEs except excluded	59%	Entities with under $5,000,000 in annual revenue are excluded
CA	IOUs except excluded	75%	Only Southern California Edison, Pacific Gas and Electric and San Diego Gas and Electric are included
CO	IOUs	57%	
HI	All LSEs except excluded	96%	Kauai Island Utility Cooperative is excluded
IA	IOUs	75%	
IL	All LSEs except excluded, State Gov.	89%	LSEs with under 100,000 customers are excluded; state government entity - Dept of Comm. and Econ. Opportunity
IN	All LSEs except excluded, 3rd Party	81%	3rd party entity - Energizing Indiana ; Munis and Co-ops not under the jurisdiction of the PUC are excluded
MA	IOUs	88%	
MD	All LSEs, State Gov.	100%	State Gov. – Energy Administration, Dept. of Housing and Community Devel., Dept. of General Services
ME	3rd Party	100%	3rd party entity - Efficiency Maine
MI	All LSEs	100%	
MN	All LSEs	100%	
NM	IOUs	68%	
NY	IOUs, State Gov.	100%	State Gov.– NYSERDA; Munis and Co-ops are excluded.
OH	IOUs, Retail Power Marketers	89%	
OR	3rd Party	69%	3rd party entity - "Energy Trust of Oregon"; targets apply to Portland General Electric and Pacific Power service territories
PA	IOUS except excluded	96%	IOUs with under 100,000 customers are excluded
RI	IOUs	99%	
TX	All LSEs	100%	
VT	3rd Party	94%	3rd party entity - "Efficiency Vermont"; City of Burlington administers its own energy efficiency programs
WA	All LSEs except excluded	81%	LSEs with 25,000 customers or less are excluded
WI	3rd Party	83%	3rd party entity-"Focus on Energy"; IOUs are required to fund "Focus on Energy," and targets apply to their service

[a] Note that "All LSEs" encompasses all types of utilities (including IOUs, Munis, co-ops, and public utilities) serving load within a state.

* See additional notes for excluded entities.

3.5 Eligible Savings Measures

Traditional energy efficiency measures, such as rebate programs for energy efficient appliances, home weatherization, and lighting replacement programs are widely accepted for compliance across EERS policies. These programs have well-established frameworks for implementation and methodologies for measurement and verification of savings (e.g., Jayaweera and Haeri 2013). In order to increase flexibility, a number of EERSs allow savings from a broader set of measures to contribute toward compliance, including changes to building codes and appliance standards, market transformation efforts, behavior-based programs, supply-side efficiency improvements, and combined heat and power or waste heat recovery applications. Broadening the definition of eligible savings measures allows for greater program ambition and more flexibility for compliance, and as a result many states are pursuing programs/measures from these categories. However, expanding eligibility to these measures also increases the challenge of producing accurate estimates of savings toward compliance, as methods for measurement and attribution of savings for some of these measures can involve a higher level of uncertainty. As a result, there is a significant amount of recent and ongoing work pursuing improved methods for estimating savings from these various measures. Methods continue to be refined, resulting in reduced uncertainty.[27] This section considers the various energy efficiency measures beyond traditional measures that can contribute to compliance in some states and the challenges associated with estimating the savings resulting from these measures.

Building Codes and State Appliance Standards: Increasing the stringency of codes and standards (C&S) and the level of compliance with C&S can result in significant reductions in energy consumption (Lee et al, 2013). As a result, it can be advantageous to allow utility-run programs that increase the rate of adoption and level of compliance with C&S to contribute toward EERS compliance. However, in order to allow C&S to contribute to EERS compliance, a robust methodology is required to estimate the overall savings associated with new or increased compliance with existing C&S and subsequently to attribute these estimated savings to individual utilities for their role in advancing C&S and improving compliance. These estimates are inherently uncertain, and as a result, there is a risk of producing inaccurate estimates of savings, as well as allowing non-additional[28] savings to contribute toward EERS compliance. Although these risks exist, given the potential for large levels of savings, some states, including California, have chosen to allow savings from C&S to contribute towards compliance. Furthermore, improved methods to attribute savings from C&S to compliance entities are under active development.[29]

Behavior-Based Programs: Behavior-based energy efficiency programs use a variety of strategies that seek to change consumer energy use behavior in order to achieve energy savings (Todd et al. 2012). Behavioral programs seek to change individual or organizational behavior and decision making about energy use through outreach, education, competition, benchmarking, and/or informational feedback programs. Examples of targeted behaviors include turning off the

[27] For additional information, see Jayaweera and Haeri (2013).

[28] *Additional savings* are savings that would not have occurred in the absence of the policy. *Non-additional savings* are savings that would have occurred in the absence of the policy.

[29] See "Attributing Building Energy Code Savings to Energy Efficiency Programs," IEE/IMT/NEEP, prepared by The Cadmus Group, 2013. http://neep.org/Assets/uploads/files/emv/emv-products/NEEP_IMT_IEE_Codes%20Attribution%20FINAL%20Report%2002_16_2013.pdf.

lights and installation of smart thermostats. Rather than directly incentivizing these changes through monetary payments (e.g., rebates or awards), behavioral programs typically try to alter decision making about end-use consumption by leveraging key economic and non-economic drivers of energy use decisions. For example, one behavioral approach is to introduce competition among energy users over who can save the most. A third-party entity provides a household with information on how their energy consumption compares with that of their neighbors. Results from these types of programs demonstrate that consumers are often competitive and will try to out-compete their neighbors by taking actions to reduce their household energy consumption. Due to their demonstrated success (Ayres et al. 2012; Allcott 2013), behavioral programs are becoming increasingly more common, and accepted methods for estimating the savings resulting from programs have been developed (Todd et al. 2012).

Other Market Transformation: Market transformation programs are designed to remove impediments to the widespread adoption of energy efficient technologies. Such barriers might be a lack of consumer awareness of the cost savings and environmental benefits of efficiency measures, manufacturer uncertainty about future demand for energy efficient products, or misinformation about the durability and quality of energy efficient goods. Market transformation programs can potentially have a large impact on efficiency investment, and therefore result in large savings. However, the relatively abstract nature of activities associated with market transformation makes it difficult to estimate the savings that occur as a direct result of these activities.[30] Thus, development of robust methods to estimate the savings resulting from market transformation efforts is crucial to ensuring that saving from market transformation efforts that contribute towards EERS compliance are real and additional.

Supply-Side[31] Efficiency Measures: Although efficiency improvements to generation, transmission, and distribution infrastructure do not directly impact end-use consumption, in some cases supply-side efficiency improvements can be more cost-effective than investments in new generation capacity. As a result, a number of states choose to allow supply-side efficiency measures to contribute toward EERS compliance. Supply-side efficiency measures typically involve improvements or replacement of components of large scale infrastructure. As a result the amount of savings resulting from these investments can be estimated with a relatively high amount of accuracy given that the calculations can be largely based on directly measureable physical changes to the generation, transmission, and distribution infrastructure, without consideration of less quantifiable drivers, such as consumer behavior. Supply-side efficiency measures may have a lower administrative cost than running a traditional end-use efficiency program, and as a result, there may be a benefit to allowing these types of measures to contribute. However, given that the investment is on the supply side, individual electricity

[30] For example, if a homeowner makes the decision to replace incandescent bulbs with LEDs, and in the homeowner's locality there is both an ongoing educational campaign about efficient lighting and a utility rebate program for LEDs, it is difficult to determine if the savings associated with this lighting retrofit are the result of the rebate program, the market transformation program (in this case an informational/education program), a combination of both, or neither.

[31] We define "supply-side" efficiency measures as any measure to improve the efficiency of generation, transmission, or distribution.

consumers do not directly benefit from reduced energy use, as they might from participating in an end-use energy efficiency program.[32]

Combined Heat and Power and Waste Heat Recovery: Combined heat and power (CHP), or cogeneration, is the simultaneous production of electricity and heat from a single fuel source. Every CHP application involves the recovery of thermal energy that would otherwise be wasted to produce additional power or useful thermal energy. Waste heat recovery is the use of otherwise wasted heat from an industrial source for other thermal applications such as space heating. Bottoming-cycle CHP or waste heat to power is the use of otherwise wasted heat from an industrial source for the production of electricity. A number of states (e.g., Massachusetts, Michigan and Connecticut) allow savings from CHP and waste heat recovery to contribute towards compliance (Hedman et al. 2013). When wasted heat is used to generate electricity, or when heat from an industrial process is applied towards a process that would have otherwise used electricity, crediting CHP and/or waste heat recovery is appropriate and relatively straightforward. However, when CHP or waste heat recovery reduces fuel use for applications other than producing electricity (e.g. natural gas used for space heating), such measures may be more suitable for crediting under other available policies (e.g. carbon policy applied to generation, renewable energy standard if using biomass, EERS for natural gas, etc.) versus under an EERS for electricity.

3.6 Cost Recovery

The costs of implementing energy efficiency programs are typically recovered through PUC-approved adjustments in electricity rates. These charges are usually in the form of either a volumetric (per kWh) charge[33] or a fixed charge on the customer's utility bill. Volumetric charges are, by definition, structured as a charge per unit of electricity consumed, and therefore customers that consume larger amounts of electricity pay a larger share of the program costs. Fixed charges, on the other hand, do not depend on total electricity consumption, and thus each customer pays the same share toward program cost, regardless of their electricity consumption.[34] These charges could be explicitly called out on a customer's electricity bill (indicating that the charge is directly for energy efficiency programs or public benefit programs), embedded in base electricity rates or other riders, or listed as some combination of both.

LSEs are responsible for the initial collection of funds from the ratepayer; thereafter, funding can take several paths before it is ultimately spent by covered entities implementing programs. In states where LSEs are required to meet targets directly, they will typically collect and administer funding themselves; in other states, public funds or trusts exist to hold and redistribute funds.

[32] There could be an indirect benefit to consumers as increased supply-side efficiency may mitigate future increases in electricity rates as a result of reduced need for new generation capacity.

[33] Volumetric charges are either built into base rates or take the form of a rider on top of base rates. For efficiency programs, riders are often referred to as a system benefit or public benefit charge. Public benefit funds may be used for a variety of energy efficiency programs, as well as for other capital investments that provide a net benefit to customers.

[34] Note that rates for different costumer classes (residential, commercial, industrial) typically differ.

In addition to direct ratepayer charges, some states provide proceeds from forward capacity markets or carbon allowance auctions to supplement other sources of funding.[35]

3.7 Cost Containment

The cost of complying with savings targets and the net impact on electricity rates (and total cost to the customer) are key concerns of utilities and state regulators in implementing EERSs. Ultimately, the PUC is responsible for assessing the total costs, cost-effectiveness, and ratepayer impacts of individual energy efficiency programs proposed by utilities to meet targets. However, in order to address concerns of compliance costs directly, a number of states have put in place cost containment provisions that limit either the total amount that can be spent on efficiency programs or the increase in electricity rates required to recover the cost of these programs. Provisions that limit total spending on efficiency programs take the form of either an aggregate spending cap (e.g., total resources spent on efficiency programs may not exceed $X) or an alternative compliance payment (ACP). ACPs allow obligated entities who fail to meet their target (either due to unexpectedly low savings from installed measures or due to failure to identify or invest in savings opportunities) to pay a fee per kilowatt-hour of savings shortfall. These payments are often considered penalties for non-compliance; however, they also act as a cost-cap as they ensure that the total cost of compliance for an obligated entity will not exceed the product of the required savings and the ACP. Table 5 lists the states that have cost containment provisions in place. To date, Illinois is the only state in which a cost containment cap has been triggered; however, as EERS targets increase in stringency and the lowest-cost efficiency options become less abundant, triggering of cost containment provisions may become more common.

Cost containment provisions provide certainty to the regulator and obligated entities that compliance will not become prohibitively expensive and will not result in increases in electricity rates beyond a chosen limit. As a result, inclusion of cost containment provisions may lessen opposition to an EERS. However, inclusion of a cost cap introduces the risk of underinvestment in energy efficiency relative to the social optimum if the cap is set below the marginal social benefit of savings. Given that it can be difficult to accurately assess the marginal benefit of savings and, therefore, to select the economically efficient level of a cost-cap, this risk should be considered when introducing or including cost-containment provisions.

[35] For example, the majority of proceeds from the auction of greenhouse gas emissions allowances under the Regional Greenhouse Gas Initiative (RGGI) are directed towards funding efficiency programs.

Table 5. EERS Cost Containment Provisions, Incentives and Penalties for Compliance/Non-Compliance, and Decoupling

	Cost Containment	Incentives	Penalties	Decoupling
AR		X		
AZ		X		X
CA	X	X	X	X
CO		X		
HI		X		X
IA				
IL	X		X	
IN		X	X	
MA		X	X	X
MD				X
ME	X			X
MI		X		X
MN		X		X
NM	X	X		
NY		X		X
OH		X	X	X
OR				X
PA	X		X	
RI	X	X		X
TX		X		
VT		X	X	X
WA	X		X	
WI	X	X	X	X

3.8 Incentives, Penalties, and Decoupling

Under a traditional regulatory structure, utilities earn revenue by selling electricity to customers. With this type of regulatory structure, procuring energy efficiency decreases overall electricity consumption, sales, and therefore, earnings to utilities. Although PUCs allow utilities to recover costs of energy efficiency measures from ratepayers, cost recovery does not account for the reduced earnings associated with the forgone revenue from decreased electricity sales.[36] As a result, in the absence of compensating policies, utilities have little incentive to procure efficiency. This disincentive to implement efficiency programs and to comply with EERSs has been addressed by states in a number of different ways.

[36] Under a traditional rate case, if a utility invests in energy efficiency measures, electricity prices are adjusted to collect the necessary revenue in order to recover costs of efficiency measures, including a return; however, this adjustment does not reflect forgone revenue resulting from the efficiency measures. Furthermore, if additional efficiency measures are implemented between rate cases, revenue (and earnings) would be further eroded.

3.8.1 Incentives and Penalties

States have designed a variety of incentives for compliance and penalties for non-compliance. Some states have implemented just one, while others have implemented both.

Eighteen of twenty-three states with EERSs offer performance incentives (or "shareholder" incentives) to utilities for achieving compliance. These incentives are typically structured as a scalable bonus or reward that is tied to the level of compliance or to the estimated net benefits[37] of a utility's suite of efficiency programs. For example, in Minnesota, the incentive ramps from $0.00/kWh-saved at a minimal level of compliance (determined annually) to $0.07/kWh-saved at 100% compliance. Utilities in Minnesota are further incentivized to over-comply with the targets up to 125% of the goal at which point the incentive reaches its maximum of $0.0875/kWh. In order to cover incentive payments, PUCs will typically set aside a portion of funds raised through ratepayer charges from which they will allocate payments to qualifying utilities.[38]

It is important to note that performance incentives represent a partial shift of benefits (or surplus) from electricity consumers to utilities/obligated entities. In the absence of incentives, consumers are the sole monetary beneficiaries of efficiency programs implemented under an EERS. However, given that ratepayers are the ultimate source of funds used to cover program costs, including incentive payments, allocation of incentives to the obligated entities shifts a portion of the benefits from consumers to producers/obligated entities. Thus, allocation of incentives allows the PUC to share or balance benefits between the consumers and producers.[39]

Nine states have established rules for monetary penalties for non-compliance; five of these also have performance incentives. Table 5 above shows states that have incentives and penalties associated with compliance and non-compliance. Penalty structures vary substantially across states. For example, Washington administers a flat volumetric fee for every megawatt-hour of energy savings shortfall below 100% compliance. In California, when utilities are below 65% compliance, utilities pay the larger of (1) a flat volumetric fee for each megawatt-hour of shortfall below 65%, or (2) the net-negative benefits[40] of their suite of energy efficiency programs.

Although penalties exist in nine states, to date not a single penalty has been levied on a utility for under-compliance with an EERS target. It remains unclear what this reveals about the relative effectiveness of penalties as an EERS design component. This could imply that the threat of

[37] Net benefits are calculated as an estimate of the monetary benefits of a utility's efficiency programs accruing to customers minus the cost of implementing the programs.

[38] In cases where the full incentive payments are not distributed to obligated entities, the remaining value of the incentive is often applied to the following year's program budget.

[39] Furthermore, in cases where performance incentives drive obligated entities to achieve savings above the target, the result can be an overall increase in total combined consumer and producer benefits.

[40] In California, energy savings are assigned a PUC-adopted dollar value that reflects the generation, transmission, distribution, and environmental costs avoided by those savings. The benefits of achieved savings are therefore the product of this dollar value and the achieved savings. The net benefits are calculated as the savings benefits minus the total costs of the programs. Programs are only approved if the expected savings benefits exceed costs (i.e. there are net positive benefits); however, after implementation of a program, if the achieved savings are less than the expected savings, costs may exceed the benefits, in which case net-benefits are negative. For additional information, see California Decision 07-09-043, http://docs.cpuc.ca.gov/PublishedDocs/WORD_PDF/FINAL_DECISION/73172.PDF.

penalty is sufficient to drive compliance, or alternatively, that the incentives, program cost recovery, and/or simply a mandate from the PUC is enough to drive compliance. Finally, it is worth noting that even in the absence of statutory penalties for non-compliance, it is within the PUCs jurisdiction to levy penalties (in various forms) on non-compliant entities.

3.8.2 Decoupling

In addition to incentives and penalties, many state PUCs also permit electricity revenue decoupling. Decoupling is designed to break the link between the amount of energy sold by a utility and the revenue collected by the utility. [41] To date, electricity revenue decoupling has been implemented in 13 of the 23 states with EERSs. In the context of energy efficiency, decoupling allows utilities to recover forgone revenue resulting from decreased electricity sales associated with demand-side efficiency improvements. In states where decoupling is available and implemented, the utility and the PUC agree on a fixed amount of revenue that the utility is entitled to receive, and the PUC allows periodic price adjustments between rate cases in order to achieve the authorized level of revenue. If efficiency improvements (or other changes) result in reduced sales, utilities are allowed to make up the lost revenue by increasing rates. On the other hand, if sales increase as a result of an increase in the number of customers served (or other effects), electricity rates are lowered to ensure that revenue does not exceed the agreed upon level.[42] As such, decoupling shifts the risk associated with changes in market conditions from utilities to customers, which can make customers better or worse off depending on the particular circumstances (Sotkiewicz 2007). For example, consumers are worse off in the first case above (due to the rate increase), while they benefit in the second case (due to the rate decrease), relative to a market without decoupling.

Decoupling, in isolation, is not sufficient to induce investment in efficiency by utilities (Brennan 2010; Eto 1997). Rather, decoupling, if successful, will eliminate a utility's disincentive to invest in efficiency programs. Additional policy measures, such as an EERS that requires utility compliance coupled with performance incentives, may be necessary to drive utilities to invest or administer efficiency programs. Indeed, as Table 5 demonstrates, every state with an EERS that employs decoupling also uses compliance incentives to promote efficiency investment.

3.9 Evaluation, Measurement, and Verification

One of the most important components of an EERS is ensuring that electricity savings reported from programs implemented under the EERS are real, additional to any savings that would have been achieved in the absence of the EERS, and accurately estimated. Without a robust process to estimate and verify these savings, states risk obligated entities reporting exaggerated or inflated estimates of program savings to the regulator and greatly reducing the effectiveness of the standard. In addition, it is important that states ensure that programs implemented under an EERS are cost-effective and operated efficiently; in order to achieve this, robust estimates of the amount of savings achieved under energy efficiency programs are necessary.

In order to ensure robust estimates of savings and assess cost-effectiveness and efficiency of programs, states have developed evaluation, measurement, and verification (EM&V) protocols.

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[41] For a more complete discussion of decoupling, see "Revenue Regulation and Decoupling: A Guide to Theory and Application," 2011, Regulatory Assistance Project.
[42] In some states, rate adjustments under a decoupling program normalize for weather and other conditions.

There are three main types of EM&V: impact evaluations, process evaluations, and market evaluations. Impact evaluations have two primary objectives: (1) to verify that energy efficiency programs have been implemented and associated measures have been installed, and (2) to estimate the amount and cost-effectiveness of savings resulting from these programs. Process evaluations are systematic assessments of the administrative efficiency and effectiveness of a program, and market evaluations assess the impact of a program on the structure or functioning of a market and the behavior of market participants.[43] The most crucial type of evaluation for ensuring the effectiveness of an EERS are impact evaluations, as they ensure that reported savings are real and have been measured or estimated using best practices available. We provide a brief overview of the key considerations in carrying out impact evaluations below.

Impact evaluations estimate *gross* electricity savings, *net* electricity savings, or in some cases, both. Gross savings refers to the change in energy consumption resulting from program-related actions taken by all consumers participating in the program. For example, if a lighting program offered high-efficiency bulbs (e.g., compact fluorescents) at no cost, the gross savings from this program would be the reduction in energy consumption resulting from program participants replacing low-efficiency bulbs with high efficiency bulbs. Gross savings are only generated by measures installed—if participants received efficient bulbs through the program, but did not install them, no savings would be associated with the distribution of those bulbs. Net savings is the change in energy consumption directly attributable to a program after accounting for:

- Non-additional savings that would have occurred in the absence of the program, often referred to as “free-ridership” in this context
- Increased savings that occur as an *indirect* result of the program, known as “spillover”
- Decreased savings as a result of “the rebound effect” or other induced market effects.[44]

Returning to our lighting example, net savings removes the gross savings associated with participants who would have purchased the bulbs in the absence of the program (free-ridership) and includes savings from non-participating consumers who were indirectly influenced by the program to purchase efficient bulbs (spillover).[45] In addition, net savings would ideally account for changes in energy consumption resulting from the decreased cost of energy services (rebound effect), as well as any other induced market effect.[46]

If the ultimate goal of an EERS is to reduce energy consumption below the level that would have been achieved in the absence of the policy, net savings is the metric most appropriate for determining whether or not a state or an obligated entity has achieved the savings target and

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[43] For a detailed description of EM&V protocols, see Schiller et al. (2012).

[44] The rebound effect refers to changes in energy consumption associated with changes in demand for an energy service that has a reduced cost as a result of an efficiency improvement. For example, replacement of incandescent bulbs with compact fluorescent bulbs greatly reduces the cost of lighting. As a result, an individual may choose to increase her use of the lights, as it costs much less to operate them. The rebound effect in this case is thus the incremental increase in energy use associated with the increased lighting demand following the efficiency improvement.

[45] Spillover occurs, for instance, if a friend of a program participant is made aware of high-efficiency bulbs after seeing them in the program participant’s house and as a result decides to replace her own less efficient bulbs.

[46] Other induced market effects include changes in energy consumption associated with reinvestment (or expenditure) of money saved as a result of the energy efficiency measure being evaluated.

whether or not the policy has been effective.[47] However, estimation of net savings can pose additional challenges relative to estimation of gross savings, and as a result, many states choose to base compliance on gross savings (Kushler et al. 2012, Kushler et al. 2014). Of the states with an EERS, eight states use gross savings, nine states use net savings, and six states use both (Kushler et al. 2012). Within the group of states that estimate net savings there is a large amount of variation in methods for estimating net savings, as well as in the breadth of effects that are accounted for (Messenger et al. 2010; Kushler et al. 2012, Kushler et al. 2014). All states that estimate net savings attempt to account for free-ridership. Twelve of these states also attempt to account for spillover. To our knowledge, no states account for the rebound effect. Variation in the approaches and methods used to estimate savings makes it difficult to directly compare estimated savings across states, as well as to compare historical levels of compliance.[48]

Table 6. Types of Savings Metrics Used for Compliance Assessment

		Effects Accounted for in Net Savings Estimates	
	Net, Gross, or Both?	Freeridership	Spillover
AR	Net	Yes	Yes
AZ	Gross	-	-
CA	Both	Yes	Yes
CO	Net	Yes	No
HI	Both	Yes	Yes
IA	Gross	-	-
IL	Net	Yes	No
IN	Gross	-	-
MA	Net	Yes	Yes
MD	Both	Yes	Yes
ME	Both	Yes	Yes
MI	Both	Yes	Yes
MN	Gross	-	-
NM	Net	Yes	No
NY	Net	Yes	Yes
OH	Gross	-	-
OR	Net	Yes	Yes
PA	Gross	-	-
RI	Net	Yes	Yes
TX	Both	No	No
VT	Both	Yes	Yes
WA	Gross	-	-
WI	Both	Yes	Yes

[47] Note that if instead, the primary objective of an EERS is to ensure that a minimum level of savings is achieved, irrespective of the additionality of savings, gross savings is a sufficient measure.
[48] There are a number of ongoing efforts to improve the consistency of EM&V across states. See, for example the Uniform Methods Project: http://energy.gov/eere/about-us/initiatives-and-projects/uniform-methods-project-determining-energy-efficiency-progr-0, accessed 5/22/14.

Another key consideration in carrying out impact evaluations is what entity is required to execute the assessment. In some states, the regulator will either carry out the assessment directly, or more commonly, will contract with an independent third-party firm to conduct the analysis. In other states, obligated entities are required to contract with a third-party analyst. Finally, in some states, the obligated entities are allowed to carry out the analysis themselves. Independent evaluations conducted directly by a regulator or by an independent contractor on behalf of the regulator, benefit from separating the obligated entity from the estimation of savings, and as a result mitigate the perverse incentive that obligated entities have (or that independent contractors working on behalf of the obligated entities have) to exaggerate or inflate savings estimates (Kaufman and Palmer 2011).

4 Summary

Under an EERS for electricity, a requirement is placed on an obligated entity or set of entities, often utilities or LSEs, to achieve a specified amount of electricity savings by a specified date. This paper explores the design and status of EERSs across states, and presents the results of an analysis that estimates the savings required under currently active and legally binding state EERSs. To date, EERSs for electricity are active and binding in 23 states. Our results indicate that existing EERSs will yield an average reduction in electricity consumption of approximately 5% below reference consumption by 2015 and potentially 8%–10% by 2020, in states with EERSs. However, the level of savings required varies significantly across states, ranging from approximately 1% (in Texas) to 15% (in New York) by 2015.

Although the basic structure of EERSs is consistent across states—each has targets, obligated entities (or entity), and an EM&V and compliance assessment process—specific design elements vary across states, including how targets are specified, what entities are obligated to comply with the targets, what types of efficiency measures are eligible to contribute toward compliance, how savings are measured, if penalties and incentives for compliance and non-compliance exist, and ultimately, what level of savings is required by the policies. These design choices ultimately determine the stringency and flexibility of the policy; the balance of customer and utility benefits, costs, and risks; and the extent to which the policy will lead to achievement of long-term energy savings. As a result, as states consider revising or implementing new EERSs, these design options should be carefully considered. Table 6 presents a summary of the design options for state EERSs for electricity and the implications of alternative design choices.

Table 7. Key Design Elements for Energy Efficiency Resource Standards for Electricity

Energy Efficiency Resource Standards for Electricity: Key Design Elements				
Target Specification				
An energy savings target is specified in absolute (e.g. MWh) or percent terms, and consists of a **type** and a **basis.** The **type** determines the vintage of measures allowed to contribute toward compliance. The **basis** is used when a target is specified as a percent, and is the quantity by which that percent is multiplied to determine an absolute amount of required savings.				
Policy Design Element		***Definition***	***Key Effects, Implications, & Considerations***	***State Examples***
Target Type	Incremental	Savings in a given year resulting from energy efficiency measures installed in that year	▪ Compliance assessment solely requires measurement of savings from efficiency measures installed in the given compliance year (i.e. focus on 1st-year savings) ▪ May incentivize lower cost measures that provide only short-term savings	CA, MA, MN
	Annual	Savings in a given year resulting from energy efficiency measures installed in that year and measures installed in prior years (as defined by the policy) that continue to provide savings	▪ Compliance assessment requires measurement of savings from efficiency measures installed in the compliance year and previous years (i.e. focus on lifetime savings) ▪ Incentivizes measures that provide both near- and long-term savings ▪ Enhances certainty of achieving long-term savings goals ▪ Increases complexity of EM&V and accounting due to erosion of savings of older measures	AZ, MD, NY
Basis Type	Fixed	The *static* quantity, typically consumption in a fixed year, by which a percentage target is multiplied to determine an absolute amount of required savings	▪ Provides certainty in the amount of required savings ▪ Amount of required savings is unresponsive to changes in market conditions	MD, NY, PA
	Rolling	The *dynamic* quantity, often consumption in the previous year, by which a percentage target is multiplied to determine an absolute amount of required savings	▪ May create uncertainty in the amount of required savings ▪ Amount of required savings adjusts to changes in market conditions	AZ, IL, OH
Obligated Entities				
Obligated entities are the institutions ultimately responsible for compliance with an EERS. Obligated entities can include all or a subset of a state's **load serving entities** (LSEs) (including investor owned utilities, electric co-ops, or municipal or state providers), **state government** offices, or **3rd party** entities.				
Load Serving Entities (LSEs)		Investor owned utilities, electric cooperatives, and municipal and state electricity providers	▪ Established customer relationship decreases barriers and cost to accessing customers and promoting programs ▪ Ability to leverage existing infrastructure, staff, and relationships developed through past efficiency program administration ▪ Potential to include EERS requirements within integrated resource planning activities ▪ LSEs may have a disincentive to procure energy efficiency[1] ▪ Restricts procurement of efficiency to within service territory of LSEs required to comply	CA, CO, MA
3rd Party		Private, non-LSE, often non-profit entities that receive ratepayer and public funding	▪ Has no disincentive to procure energy efficiency ▪ Procurement of EE is possible across all service territories ▪ Potentially increases initial effort and cost of establishing the new entity ▪ Potential comparative advantage of an entity dedicated solely to design, implementation, and administration of EE programs	MI, VT, WI
State Government		State Government offices, often those affiliated with energy, public housing, or potentially air quality	▪ Has no disincentive to procure energy efficiency ▪ Procurement of EE is possible across all service territories ▪ Fiscal, procurement, and hiring rules may limit flexibility in contracting, staff acquisition, and financial operations ▪ Efficiency funding could be at risk under changing state government priorities	IL, MD, NY

Eligible Savings Measures			
Electricity savings from traditional[2] energy efficiency measures, such as rebate programs for energy efficient appliances, home weatherization, and light-bulb replacement programs are widely accepted for compliance across EERS policies. Expanding the set of eligible measures to include building codes and appliance standards, behavior-based programs, other market transformation efforts, supply-side efficiency improvements, and combined heat and power expansion increases flexibility for compliance with the standard and can potentially reduce compliance costs, but may also increase the complexity of measuring savings. In addition, these additional measures have the potential to create market-scale and long term impacts. As a result, broadening the set of eligible measures may allow states to target a higher level of electricity savings.			
Building Codes and Appliance Standards	Saving associated with improving compliance with current codes and standards, or advancing the adoption of more stringent codes and standards	▪ Large potential savings ▪ Increases challenge of attributing resulting savings to individual obligated entities	AZ, NY, CA
Behavior-Based Programs	Programs designed specifically to impact consumer decision making around energy use, often through the provision of tailored information to individual consumers	▪ Large potential savings ▪ Use of randomized-controlled trials[3] can provide robust estimates of savings ▪ Recent programs have demonstrated short-term impacts; long-term impacts are unclear	CA, MA, MN
Other Market Transformation Programs	Broad activities designed to create lasting change in market behavior by removing identified barriers or exploiting opportunities to accelerate the adoption of energy efficiency	▪ Large potential savings ▪ Increases challenge of attributing resulting savings to individual obligated entities	NY, TX, WA
Supply-Side Measures	Efficiency upgrades to generation, transmission and distribution infrastructure	▪ Large potential savings ▪ Customers benefit indirectly - there is no reduction in end-use electricity consumption ▪ Robust measurement of savings can be achieved through simple engineering based calculations	DE, NY, OH
Combined Heat and Power; Waste Heat Recovery	Facilities simultaneously produce electricity and heat from a single fuel source; facilities that use otherwise wasted heat (e.g. from industrial processes) for electricity generation (CHP, waste heat to power) or for other thermal applications (waste heat recovery)	▪ Large potential savings ▪ Customers beyond those that have CHP benefit only indirectly (there is no reduction in end-use electricity consumption), while customers that have CHP benefit directly ▪ Determining the relative contribution to compliance presents a challenge but has been addressed by states such as Massachusetts, Michigan, and Connecticut	AZ, HI, MN
Cost Containment Mechanisms			
Cost containment mechanisms are limits placed on either the total cost of the program or the increase in electricity rates required to recover the cost of the program. They are implemented using rate impact caps, annual spending caps (typically a percent of operating revenue), or caps on specific components of individual programs (e.g. administrative costs).			
Cost Containment Mechanisms		▪ Shields ratepayers from significant rate increases ▪ Increases the risk of under-investment in efficiency relative to program goals, limiting overall savings if mechanisms are triggered	IL, RI, WI
Ensuring Compliance			
Compliance with energy savings requirements can be encouraged in a variety of ways. Financial **incentives** or **penalties** often exist that scale with compliance levels. **Revenue decoupling** breaks the link between LSE revenues and sales volume, and therefore removes the disincentive to procure energy efficiency.			
Incentives	Structured financial award, typically a volumetric, scalable bonus tied to the level of compliance or estimated net benefits of a suite of energy efficiency programs	▪ Provides incentive to achieve full compliance, and potentially over-compliance ▪ Shifts a portion of benefits from ratepayers to obligated entities	CO, MN, VT
Penalties	Structured monetary fine, typically a volumetric, scalable fine tied to the level of compliance	▪ Provides disincentive for non-compliance	CA, MA, WA
Revenue Decoupling	A mechanism to break the link between utility energy sales and revenues	▪ Removes LSE disincentive to procure EE ▪ Changes the exposure to market risk faced by producers and consumers	AZ, CA,RI

Evaluation, Measurement, and Verification (EM&V)				
Evaluation, Measurement, and Verification (EM&V) is the process by which the amount and cost-effectiveness of savings from energy efficiency programs are estimated and evaluated. Savings can be measured on either a **gross** or **net** basis (or both). The **responsibility for conducting EM&V** can fall on either the regulator, the obligated entity, or in some cases a combination of the two; although the ultimate responsibility falls on either the obligated entities, the PUC, or both, these institutions often rely on a 3rd party to carry out the evaluations.				
Metric	Gross Savings	Savings resulting from program-related activities by all participating consumers, without consideration of savings that may have occurred in the absence of the program, or other secondary effects	▪ Reduces the complexity of estimating savings ▪ Does not account for free ridership, spillover, program overlap, or other market effects	AZ, OH, PA
	Net Savings	Savings resulting from program-related activities by all participating consumers which deducts savings that may have occurred in the absence of the program and accounts for other secondary effects	▪ Increases the complexity of estimating savings ▪ Can account for free ridership, spillover, and broader market effects (e.g, rebound)	CA, CO, MA
Responsibility for Conducting EM&V	Obligated Entities		▪ Can create incentive to exaggerate savings estimates & minimize spending on EM&V ▪ LSEs have significant experience carrying out EM&V of rate-payer funded programs	CO, MA, PA
	Public Utilities Commission		▪ Creates incentive to seek out robust estimates of savings	HI

Notes:

[1]Disincentives to procure energy efficiency result from the fact that successful efficiency measures reduce electricity sales and therefore the potential for earnings. These disincentives may not be a concern for not-for-profit LSEs including co-ops, munis, and other publicly owned LSEs.

[2]Although we refer to programs/measures such as home-weatherization, light-bulb replacement, and appliance rebates as "traditional" measures, and other as "non-traditional" it is important to note that programs/measures considered "non-traditional" have been implemented successfully in a number of states and for many years.

[3]Randomized controlled trials can also be used to calculate robust estimates of the savings resulting from other types of measures/programs as well, although historically this has not been common outside of behavioral programs.

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Appendix A. Detailed Methods—Required Savings Analysis

Given the substantial amount of variation in how EERS targets are specified—incremental vs. annual, absolute vs. percentage, fixed vs. rolling—it is difficult to directly compare the stringency and expected impacts of EERS policies across states based on the nominal targets. Here we present an analysis that compares the stringency of state EERSs by calculating the electricity savings required under existing and active state EERSs from 2010–2020. We control for the differences in how targets are specified as well as the percent of total load covered by the policy. We present the normalized savings targets in terms of annual savings.

This appendix describes the methods used to calculate the savings required under state EERS policies from 2010–2020.

Load Projection

First, we developed a load projection for each state using data on current state electricity consumption and projected load growth from the 2012 Annual Energy Outlook (AEO12). Regionally specific growth rates in electricity sales from the AEO2012 for the years 2011–2020 were applied to reported electricity sales for the year 2010 for each state.[49] This resulted in projected electricity sales by state for 2010 through 2020. This load projection is assumed to represent the annual quantity of electricity that would have been consumed in the absence of the EERS policy. We call this projection the *reference case* or the *reference consumption* interchangeably.

It is important to note that the National Energy Modeling System (NEMS), which is used to generate the annual energy outlook projections, is calibrated to historical energy consumption and thereby implicitly assumes a continuation of historical trends in energy efficiency change. Given that many states with EERSs have had active energy efficiency programs for many years, some of the energy efficiency that could contribute toward EERS compliance may already be implicitly represented in the AEO baseline. We do not expect this to have a significant impact on our results, particularly the percent reductions reported; however, it could result in slightly exaggerated levels of required savings.

Covered Load

For each state, we calculated the percent of total load that is effectively covered by the EERS. As discussed earlier, some states limit the coverage of the policy to IOUs, to utilities/LSEs with a minimum threshold of sales, or, in the case of a third-party administered program, based on the jurisdiction of the third-party entity. Although these entities typically account for the majority of electricity sales within a state, in many states some portion of a state's total load is not covered, which reduces the overall impact of the policy at the state level. Covered load ranges from 57%–100% of total load.

[49] The National Energy Modeling System (NEMS), which is used to conduct the AEO, has 22 electricity regions within the Electricity Market Module (EMM). Load growth within each region is applied to all states falling within the geographic extent of the EMM region.

Target Harmonization

In order to directly compare the stringency of these policies across states, we use the nominal target specification and the projected reference consumption to estimate the annual electricity savings required by year in absolute terms. For states with nominal targets specified in absolute terms (i.e., in gigawatt-hours of savings per year or similar), no calculation was necessary beyond converting between incremental and annual savings. For states with percentage targets, the methodology employed depended on whether the targets reference a fixed or rolling basis. For states that use a fixed basis, we first calculated the basis consumption level using historical load,[50] excluding any portion of the load that is not covered under the policy. The required savings in future years was then estimated by multiplying the covered basis load by the annual percentage targets.

For states that use a rolling basis, the calculation is somewhat more complex because the savings requirements in future compliance years are impacted by the savings achieved in prior years—the basis changes with the compliance year. Given this, our approach requires that we dynamically update the basis, taking into account the impact of past year savings on basis. In order to do this we calculate the absolute savings required in sequential annual steps, continually updating the impact of prior year savings on the basis. It is easiest to understand this through an example. Assume that a state has a projected reference consumption of 1,000 GWh in 2013, 1,110 GWh in 2014, and 1,200 GWh in 2015 and has incremental savings targets of 1% of the prior year's load in 2014 and 2% in 2015. In order to calculate savings in 2014, we simply multiply 2013 load (1,000 GWh) by the target (1%), which results in required incremental savings of 10 GWh. Now, in order to calculate the required savings in 2015 we must adjust the 2014 basis to reflect the additional savings of 10 GWh. Hence, the required savings in 2015 would be the 2014 reference load minus the 2014 required savings, or 1,100 GWh, multiplied by the percentage target (2%), which yields 22 GWh. Estimates of savings in future years would follow this same process, whereby the basis is recalculated annually after accounting for the impact of savings from measures installed in prior years.

There are two implicit assumptions in this calculation. First, we assume that states achieve 100% of their target savings in all years. Second, we assume that savings from measures installed in early years of the analysis period continue to provide savings throughout the entire period without degradation of their performance. Additionally, we assume that savings from measures installed prior to 2010 do not count toward compliance. In some state programs, measures that were installed prior to 2010 are allowed to contribute toward compliance if those measures continue to provide savings; however, this only applies to a small number of states and should not significantly impact the results.

Lastly, a number of states' targets terminate before 2020. Therefore, in order to estimate the required savings in years following the termination year, we must make some assumption about the future trajectory of these states' targets. Given the high degree of uncertainty in how different states will extend their targets in the future, we estimate the savings required under EERSs using

[50] Only one state, New York, has percentage targets that reference a future fixed year basis (2015). However, the New York State Public Service Commission, translates these percentage targets into absolute targets, and thus we do not need to use a projected electricity consumption in 2015 to estimate savings. Historical load data was compiled from the Energy Information Administration's form EIA-860.

two different approaches to extending targets. Under the first approach, we assume that the savings required in the years without specified targets are equal to the annual savings required in the final target year. This effectively means that we assume no additional incremental savings on top of what is currently required by policy in the final year. This approach will generally make states with only near-term targets appear less stringent than states with longer-term targets, as states can realistically implement much greater savings goals over a longer timeframe.

Under the second approach, we assume that the incremental savings required in the years without specified targets is equal to the incremental savings required in the final target year. In contrast to the preceding approach, this method may exaggerate the level of savings required by 2020 in states with near-term targets, but only if those states require a significant amount of incremental savings in the final target year of the policy—most states do not have very high incremental targets in the final year, but this may be a concern with regard to estimates for Maryland, Massachusetts, and New York. In addition, we present the required annual savings in years 2015 and 2020. Given that most states have targets specified at least through 2014 or 2015, the target extension approach has minimal impact on the 2015 values presented. Given the uncertainty in the projected targets for states with targets that terminate prior to 2020, we stress the much greater degree of certainty in the 2015 results.

Table A-1 shows our estimates of the annual electricity savings required by EERSs in all states with currently active and legally binding policies. The annual savings requirements shown refer to the amount of annual savings required in the specified year. The method type refers to the approach used to extend targets for states with targets that terminate prior to 2020.

Table A-1. Estimates of the Required Savings in 2015 and 2020 Under Currently Specified State EERSs

		Method 1 - Annual Savings Held Constant in Final Year of Target		*Method 2 - Incremental Savings Held Constant in Final Year of Target*	
State	**Final Year of Target**	**Annual Savings Required in 2015 (% of State Load)**	**Annual Savings Required in 2020 (% of State Load)**	**Annual Savings Required in 2015 (% of State Load)**	**Annual Savings Required in 2020 (% of State Load)**
AR	2014	2.7%	2.5%	2.7%	6.2%
AZ	2020	5.3%	11.4%	5.3%	11.4%
CA	2014	4.0%	3.8%	3.0%	6.5%
CO	2020	3.7%	7.7%	3.7%	7.7%
HI	2030	11.0%	19.0%	11.0%	19.0%
IA	2013	3.8%	3.8%	5.6%	10.0%
IL	2020	6.5%	14.4%	6.5%	14.4%
IN	2019	3.8%	9.2%	3.8%	10.7%
MA	2015	10.8%	10.6%	10.8%	21.1%
MD	2015	14.2%	14.7%	14.2%	27.2%
ME	2016	7.1%	8.2%	7.1%	12.9%
MI	2020	5.1%	9.7%	5.1%	9.7%
MN	2020	8.7%	15.3%	8.7%	15.3%
NM	2020	3.6%	5.2%	3.6%	5.2%
NY	2015	15.0%	15.0%	15.0%	27.5%
OH	2025	4.6%	10.3%	4.6%	10.3%
OR	2014	4.7%	4.5%	5.7%	10.5%
PA	2016	4.3%	5.0%	4.3%	7.8%
RI	2014	8.4%	8.3%	10.8%	22.7%
TX	2020	1.1%	2.6%	1.1%	2.6%
VT	2014	9.9%	9.8%	11.8%	21.0%
WA	2021	4.7%	8.1%	4.7%	8.1%
WI	2014	2.7%	2.6%	3.3%	6.6%

Our estimates show that annual savings required by state EERSs range from approximately 1% to 15% of reference consumption in 2015 irrespective of the approach used to extend targets and from 2% to 19% or 2% to 27% in 2020, depending on whether target extensions are based on annual or incremental savings.

The consumption weighted mean of the annual savings required as a percent of total load is approximately 5% in 2015. This suggests that in states with EERSs, if targets are fully met, on average, electricity consumption in 2015 will be 5% lower than it would have been in the absence of the policy. By 2020, we estimate that consumption would be, on average, approximately 8%–10% below reference consumption in states with EERSs depending on how states extend their targets in future years. This is equivalent to achieving incremental savings of approximately 0.7%–1% per year.

Arizona, Hawaii, Massachusetts, Maryland, New York, and Vermont appear to require the largest amount of savings. These states all require annual savings of 9% to 15% by 2015 and savings of 10% to 20% or 11% to 27% by 2020, depending on how states extend their targets in future years. Arkansas and Texas require the least amount of annual savings—between 1% and 2.5% savings by 2015.

Our estimates, in particular results from Method 2 that extend targets based on incremental savings, are largely consistent with prior analyses of state EERSs and ratepayer-funded energy efficiency programs. Palmer et al. (2013), in an analysis of the impact of state EERSs on electricity consumption, estimate that state EERSs will result in annual savings of 12.7% in 2020 assuming all targets are met. Similarly, Sciortino et al. (2011) extrapolate state EERS targets out to 2020 and estimate the electricity savings required to meet these targets. Table A-2 compares state-level results from this study to those from Palmer et al. and Sciortino et al.

Table A-2. Comparison of Analyses Estimating Electricity Savings Required Under State EERSs

		2020 Annual Savings Requirement (% of State Load)			
State	Final Year of Target	This Analysis (Method 1)	This Analysis (Method 2)	Palmer et al. (2013)	Sciortino et al. (2011)
AR	2014	2.5%	6.2%	6.2%	6.8%
AZ	2020	11.4%	11.4%	18.2%	22.0%
CA	2014	3.8%	6.5%	16.2%	12.9%
CO	2020	7.7%	7.7%	14.9%	14.9%
HI	2030	19.0%	19.0%	21.0%	18.0%
IA	2013	3.8%	10.0%	13.4%	16.1%
IL	2020	14.4%	14.4%	16.1%	18.0%
IN	2019	9.2%	10.7%	12.6%	13.8%
MA	2015	10.6%	21.1%	22.3%	26.1%
MD	2015	14.7%	27.2%	26.9%	26.7%
ME	2016	8.2%	12.9%		13.4%
MI	2020	9.7%	9.7%	9.6%	10.6%
MN	2020	15.3%	15.3%	14.7%	16.5%
NM	2020	5.2%	5.2%	8.7%	8.1%
NY	2015	15.0%	27.5%	27.3%	26.5%
OH	2025	10.3%	10.3%	11.1%	12.1%
OR	2014	4.5%	10.5%		10.4%
PA	2016	5.0%	7.8%	8.2%	10.0%
RI	2014	8.3%	22.7%	23.0%	25.3%
TX	2020	2.6%	2.6%		4.6%
VT	2014	9.8%	21.0%	25.3%	27.0%
WA	2021	8.1%	8.1%		17.2%
WI	2014	2.6%	6.6%		13.5%

State-level results are largely consistent across studies; however, there are a few key differences to note. First, the estimates from this study are, on average, slightly lower than those from Palmer et al. (2013) or Sciortino et al. (2011). This is likely a result of the fact that both Palmer et al. and Sciortino et al. report 2020 annual savings as a percent of covered load, while we estimate savings as a percent of total load. Given that load coverage ranges from approximately 50% to 100% across states, required savings as a percent of total load will always be less than required savings as a percent of covered load (except for the case when covered load is equal to total load). This difference in accounting also explains the significant difference in savings estimates for Colorado, as the load coverage in Colorado is relatively low at 57%. Lastly, differences across the three studies in their approaches to projecting future consumption, extending targets, and calculation of the percent of load covered by the policy also contribute to differences across studies.

Finally, in a national analysis of the impacts of future investment in ratepayer-funded energy efficiency programs on electricity consumption, Barbose et al. (2013) estimate that ratepayer-funded programs (across all states, not just those with EERSs) will result in average incremental savings of approximately 0.72% of national electricity consumption between 2010 and 2025 (under their medium energy efficiency program funding-case), which is equivalent to annual savings of approximately 11.5% by 2025. In states with EERSs (as identified in this study), Barbose et al. projects incremental savings of 16.3 TWh, 20.8 TWh, and 27.1 TWh in 2015, 2020, and 2025, respectively. Dividing these results by the reference case consumption projections developed in this analysis implies incremental savings as a percent of consumption in EERS states of approximately 0.8% and 0.9% in 2015 and 2020, respectively, which is in the middle of the range of savings required by state EERSs, as found in this analysis.